ANSWER KEY & MARKING SCHEME · CBSE CLASS 12

Numbers, Quantification and Numerical Applications

Applied Mathematics · Chapter 1 · Use this with the Board Paper · Companion to Quick Drill

HOW TO USE

Attempt the Board Paper first (closed-book, full time). Then come here. For 2-mark+ questions, compare your answer to the model. For 3-4 mark questions, also consult the **Topper Templates** below — these show the exact step-by-step structure that scores full marks per CBSE marking-scheme conventions.

MODEL ANSWERS · BOARD PAPER

Section A — Short calculation (2 × 3 = 6 marks)

Q1. **If today is Friday, what day of the week will it be 75 days from now? Show your modular reasoning.** **[2 marks]**

> **Ans:** See topper template / marking notes for the model answer; refer to chapter notes deck for full reasoning.

Q2. **Find x such that $x \equiv 4 \pmod 9$ and $30 < x < 40$.** **[2 marks]**

> **Ans:** See topper template / marking notes for the model answer; refer to chapter notes deck for full reasoning.

Q3. **Solve the inequality $-2x + 6 \geqslant 0$ and represent the solution on a number line.** **[2 marks]**

> **Ans:** See topper template / marking notes for the model answer; refer to chapter notes deck for full reasoning.

Section B — Word problem (3 × 4 = 12 marks)

Q4. **Two grades of coffee, costing ₹240/kg and ₹360/kg, are mixed to obtain a blend costing ₹300/kg. In what ratio should the two grades be mixed? Verify your answer by the weighted-average check.** **[3 marks]**

> **Ans:** Full mark-by-mark model answer is in topper_answer_templates (see chapter notes). Marking scheme reward criteria: textual reference / formula application / final inference.

Q5. **A boat goes 45 km downstream in 3 hours and the same distance upstream in 5 hours. Find the speed of the boat in still water and the speed of the stream.** **[3 marks]**

> **Ans:** Full mark-by-mark model answer is in topper_answer_templates (see chapter notes). Marking scheme reward criteria: textual reference / formula application / final inference.

Q6. **A vendor wants to earn a profit of at least ₹4,500 in a week. If the profit per item sold is ₹375, find the minimum number of items they must sell. Show the inequality.** **[3 marks]**

> **Ans:** Full mark-by-mark model answer is in topper_answer_templates (see chapter notes). Marking scheme reward criteria: textual reference / formula application / final inference.

Q7. **Pipe A fills a tank in 5 hours; pipe B (a leak) empties it in 20 hours. With both open, find the time to fill the tank.** **[3 marks]**

> **Ans:** Full mark-by-mark model answer is in topper_answer_templates (see chapter notes). Marking scheme reward criteria: textual reference / formula application / final inference.

Section C — Long-answer (6 × 2 = 12 marks)

Q8. **A shopkeeper has 80 kg of a mixture of two grades of rice in the ratio 3 : 2, costing Rs 35/kg and Rs 50/kg respectively. Find the cost per kg of the mixture and, if the shopkeeper sells the whole stock at 25% profit, find the total selling price.** **[6 marks]**

> **Ans:** Cost per kg = (3·35 + 2·50)/5 = (105+100)/5 = Rs 41/kg. Total cost = 80·41 = Rs 3,280. SP at 25% profit = 3,280·1.25 = Rs 4,100. (Equivalent SP/kg = Rs 51.25/kg.)

Q9. **A factory produces two toys A and B. Each A needs 2 labour-hours and 1 unit of material; each B needs 1 labour-hour and 2 units of material. Daily availability: 60 labour-hours and 80 units of material. Write the constraints on x (units of A) and y (units of B), and find the maximum value of x + y by checking corner-points algebraically.** **[6 marks]**

> **Ans:** Constraints: $2x + y \leqslant 60$; $x + 2y \leqslant 80$; $x, y \geqslant 0$. Corner points: (0,0), (30,0), (20,30) (intersection of $2x+y=60$ & $x+2y=80 \rightarrow 3x=40 \rightarrow$ invalid integer; check (0,40) on boundary of $x+2y=80$). Valid integer corners: (30,0) $\rightarrow x+y=30$; (0,40) $\rightarrow x+y=40$; (20,30): $2{\cdot}20+30=70$ violates 60. Best corner: (0,40), $x+y = 40$.

★ TOPPER ANSWER TEMPLATES

3 TEMPLATES · MEMORISE THE FORMAT

★ TOPPER TEMPLATE — 3 marks: 'If today is Monday, what day will it be after 80 days?'

Annual

Step 1 **[1 mark]**	**Translate to modular form**	There are 7 days in a week. The day after N days is found by computing N mod 7 and counting that many days forward from today. We need 80 mod 7.
Step 2 **[1 mark]**	**Compute the remainder**	Divide 80 by 7: 7 × 11 = 77, remainder = 80 – 77 = 3. Hence $80 \equiv 3 \pmod 7$. That is, after 80 days, the day is 3 weekdays beyond Monday.
Step 3 **[1 mark]**	**State the answer in words**	Counting 3 days from Monday: Tuesday (1), Wednesday (2), Thursday (3). Therefore, after 80 days, the day will be THURSDAY. Note that the question would have a different answer if it asked for 80 days BEFORE Monday — in that case count backwards: Sunday, Saturday, Friday.

COMMON LOSS OF MARKS:

- Computing 80/7 = 11.4 and answering '11.4 weeks' — the answer must be a day of the week.
- Counting from Monday as 'day 0' versus 'day 1' inconsistently — pick one convention and apply it cleanly.
- Not showing the remainder calculation explicitly. Examiners want the modular step visible.

★ TOPPER TEMPLATE — 4 marks: 'A shopkeeper mixes two varieties of tea costing ₹350/kg and ₹500/kg to obtain a mixture costing ₹430/kg. In what ratio should they be mixed?'

Annual

Step 1 **[1 mark]**	**Identify cheaper, dearer, mean**	Cheaper price (C) = ₹350/kg. Dearer price (D) = ₹500/kg. Mean price (M) = ₹430/kg. Confirm M lies between C and D: 350 < 430 < 500 ✓. (If M were outside this range, no positive mixture would exist.)
Step 2 **[1 mark]**	**Apply the allegation rule**	Allegation rule: (quantity of cheaper) : (quantity of dearer) = (D – M) : (M – C). Substituting: (500 – 430) : (430 – 350) = 70 : 80 = 7 : 8.
Step 3 **[1 mark]**	**Verify with a check**	Quick verification: take 7 kg cheaper (cost = 7 × 350 = ₹2450) + 8 kg dearer (cost = 8 × 500 = ₹4000). Total = 15 kg costing ₹6450. Per kg = 6450 ÷ 15 = ₹430. ✓ Matches the stated mean — ratio is correct.
Step 4 **[1 mark]**	**State the answer with units**	The two varieties must be mixed in the ratio 7 : 8 (cheaper : dearer). For every 7 kg of ₹350 tea, the shopkeeper must add 8 kg of ₹500 tea to obtain a mixture costing ₹430/kg.

COMMON LOSS OF MARKS:

- Stating the ratio as (cheaper : dearer) but giving the numerators in the wrong order. The differences EXCHANGE sides — (D–M) goes on the cheaper side, (M–C) on the dearer side.
- Not verifying with a check. The verification step is worth 1 mark and catches sign mistakes.
- Forgetting units (kg) in the final ratio statement.

★ TOPPER TEMPLATE — 3 marks: 'A boat covers 24 km downstream in 2 hours and the same distance upstream in 3 hours. Find the speed of the boat in still water and the speed of the stream.'

Annual

Step 1 **[1 mark]**	**Compute downstream and upstream speeds**	Downstream speed = distance ÷ time = 24 ÷ 2 = 12 km/h. Upstream speed = 24 ÷ 3 = 8 km/h. Recall: downstream speed = (boat + stream); upstream speed = (boat – stream).
Step 2 **[1 mark]**	**Apply the formulas**	Speed of boat in still water = (downstream + upstream) ÷ 2 = (12 + 8) ÷ 2 = 10 km/h. Speed of the stream = (downstream – upstream) ÷ 2 = (12 – 8) ÷ 2 = 2 km/h.
Step 3 **[1 mark]**	**State and check**	Therefore, the boat's speed in still water is 10 km/h and the stream's speed is 2 km/h. CHECK: 10 + 2 = 12 ✓ (matches downstream); 10 – 2 = 8 ✓ (matches upstream). Both consistency checks pass.

COMMON LOSS OF MARKS:

- Reversing downstream and upstream signs (the most common 1-mark loss in this chapter).
- Not stating units (km/h).
- Skipping the consistency check — it is mechanical and worth ½-1 mark depending on the marking scheme.

MARKING SCHEME — GENERAL NOTES

- On modulo questions, ALWAYS show the remainder calculation explicitly (e.g. '80 = 7×11+3').
- Allegation: ALWAYS verify with weighted-average check (saves last mark on sign errors).
- Boats: state BOTH consistency checks (down+up=2b, down−up=2s) — earns ½-1 mark.
- Pipes: convert to RATES first; never average times. Leaks are NEGATIVE rates.
- Inequality: explicitly call out the sign-flip when dividing by negative — examiners look for this annotation.